Transportation Synthesis Report

Research and Communication Services
Wisconsin Department of Transportation
608-261-8198
wisdotresearch@dot.state.wi.us
Request a TSR: pat.casey@ctcandassociates.com

Bridge Deck Surface Treatment Practices Of Five Midwest State DOTs

Prepared for
Bureau of Technical Services

Prepared by
CTC & Associates LLC
WisDOT Research & Communication Services
November 20, 2006

Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT technical staff. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete.

Request for Report

The Bureau of Technical Services is interested in learning about the experience of neighboring states in the use of protective surface treatments for bridge decks, both at the time of construction and as a maintenance tool. Issues of particular interest to the bureau are sealant products approved for use in other states, frequency of resealing, and cost-benefit information. A 2005 study (0092-03-06) completed by the Wisconsin Highway Research Program on Evaluation of Concrete Deck and Crack Sealers provided results of freeze-thaw lab tests on several sealant products. See the final report, http://www.dot.wisconsin.gov/library/research/docs/finalreports/03-09concretesealers-f.pdf and the Research Brief, http://www.dot.wisconsin.gov/library/research/docs/briefs/03-09concretesealers-b.pdf.

Summary

A survey of regional Research Advisory Committee members drew responses from five states – Illinois, Kansas, Minnesota, Missouri, and Ohio.

Responses indicate that the use of sealants as a preventive maintenance procedure for new bridge decks and as a follow-up treatment does not enjoy widespread practice. The agencies tend to focus more on the use of crack sealants, because cracking distress can seriously shorten bridge deck life. Deck sealing is perceived as a shorter-term preventive maintenance treatment not necessarily shown to be cost-effective. Kansas, for example, favors extra-sturdy concrete overlays and epoxy-coated rebar rather than sealants, which in past studies it has found to be ineffective at preventing chloride intrusion.

Nevertheless, the practice of sealing decks in these states is gaining champions in Illinois, Minnesota, and Missouri, where state agencies continue to evaluate sealant performance. Use of sealants appears to be inexpensive and recent studies have found effective products, such as solvent-based silane sealants. Missouri has found linseed oil in a 50-50 mix with mineral spirits to remain its most effective sealing material.

Minnesota and Missouri cited use of the WRHP study on Concrete Deck and Crack Sealers. This study determined that solvent-based sealants achieved greater penetration than water-based or siloxane sealants, though freeze-thaw cycles continue to present challenges that WisDOT is evaluating.

Our report begins with the **Survey** questions and a **Survey Response Table** for a quick comparison of state responses. We then follow with state-by-state summaries of survey responses.

Survey

We surveyed several Midwestern state transportation agencies regarding their practices in bridge deck sealing at initial construction and as a preventive maintenance strategy. The following questions were posed, and will be repeated in the entries for each state.

- Do you use protective surface treatments on new bridge decks?
- Do you reseal bridge decks with protective surface treatments? If yes, how often?
- Which products do you allow?
- How do you approve protective surface treatment products for use in your state?
- Cost-benefit information for resealing bridge decks?

Survey Response Table

Bridge Deck Sealing Practices
WisDOT Survey of Midwest RAC Members

Survey	Illinois	Kansas	Minnesota	Missouri	Ohio
Use Sealers on New Decks?	yes	no	only in 1 district	50% linseed oil, 50% mineral spirits, at construction, 2nd application after 1 year	no
Reseal Decks? Frequency?	no	no	yes, on district-developed schedule, with solvent-based, 40% silane product	no	repair and seal on case-by-case basis; preventive maintenance recommends seal every 5 years
Sealing Products	17 products; www.dot.il.gov/materials/bridgeseatsealers.pdf	n/a	Hydrozo Silane 40, Chemex; Sonneborn Penetrating Sealer 40 VOC, Chemex; Penseal 244, Vexcon; approved substitute.	linseed oil and mineral spirits; special approval has been granted to reactive silicate sealers	approved silane or siloxane
Approval Process	Illinois modified version of ASTM C672	n/a	acceptance testing specifications in process	AASHTO and ASTM certification	internal process, Qualified Products List
Cost Benefit	under analysis	n/a	under analysis; seek 50-75 year bridge life	3 yr service life, $0.017/sq. ft.	n/a

Illinois

Illinois DOT uses protective coatings but does not reseal. Currently the department is conducting a five-year study, which will conclude in 2008, on sealant practices on 60 structures. Results have been promising.

Do you use protective surface treatments on new bridge decks?

- Protective coat required on all new bridge decks
- Contractor may use approved concrete sealer as substitute

Do you reseal bridge decks with protective surface treatments? If yes, how often?

- No

Which products do you allow?

- Approved list includes 17 products, http://www.dot.il.gov/materials/bridgeseatsealers.pdf
- List updated periodically; not all products on this list appropriate for every deck surface

How do you approve protective surface treatment products for use in your state?

- Use modified version of ASTM C672
- Sealers – average visual rating of test specimens divided by average visual rating of untreated specimens, must not exceed 0.80 after 60 cycles

Cost-benefit information for resealing bridge decks?

- Process currently under research analysis
- Study concludes in 2008
- 60 structures, evaluated for five years
- Results positive so far
- Still evaluating: effective life of treatments, re-application needs; laboratory tests for acceptance of products; skid resistance data

Respondent. Thomas Winkelman, Research Engineer, Bureau of Materials and Physical Research, Illinois Department of Transportation. 217.782.2940, Thomas.Winkelman@illinois.gov.

Kansas

Studies conducted in the 1980s and 1990s set Kansas DOT's current practice of not using liquid sealants, which proved not to be cost-effective in resisting chloride penetration. Kansas instead opts for thick concrete covers and epoxy-coated rebar.

Do you use protective surface treatments on new bridge decks?

- No

Do you reseal bridge decks with protective surface treatments? If yes, how often?

- No

Which products do you allow?

- NA

How do you approve protective surface treatment products for use in your state?

- NA

Cost-benefit information for resealing bridge decks?

- NA

Comments. Studies conducted in 1980s and 1990s set practice in Kansas. Studies showed liquid sealants did not offer cost-effective chloride intrusion resistance. As a result, Kansas DOT:

- Does not use liquid sealants
- Uses impermeable deck design: 3-inch cover, epoxy-coated rebar, 1.5-inch silica fume deck overlays for high-traffic sites
- Maintenance of cracked decks entails sealing with two-coat broom and seed polymer concrete overlay
- Same two-coat overlay treatment may be used in repair

Respondent. Dick McReynolds, Engineer of Research, Kansas Department of Transportation. 785.296.2231, dick@ksdot.org.

Minnesota

Minnesota does not currently have a statewide policy on sealing new bridge decks, but is conducting an internal cost-benefit analysis of deck cracking and sealant performance. Mn/DOT currently employs the recommendations of the WHRP Study, 0092-03-09, Evaluation of Concrete Deck and Crack Sealers from August of 2005.

Do you use protective surface treatments on new bridge decks?

- One subdistrict has for 10 years, but not other subdistricts

- Practice may be expanded statewide

Do you reseal bridge decks with protective surface treatments? If yes, how often?
- In above subdistrict, which does so regularly
- Formerly used water-based silane product, which proved ineffective
- Currently use solvent-based, 40% silane product; effectiveness not yet evaluated

Which products do you allow?
- Follow recommendations of WHRP Project 0092-03-09, Evaluation of Concrete Deck and Crack Sealers
- Hydrozo Silane 40 by Chemex
- Sonneborn Penetrating Sealer 40 VOC by Chemex
- Penseal 244 by VExcon
- Approved substitute

How do you approve protective surface treatment products for use in your state?
- Process under development
- Use WHRP recommendations until acceptance testing specifications developed

Cost-benefit information for resealing bridge decks?
- Cost-benefit analysis of sealing as standard practice state wide is in process
- Concerns include: interaction of curing compounds and sealants; cracking impact on deck life
- Seek deck lives that match average structure life
- For out-state bridges, 75 years; Metro bridges, 50 years
- Currently expect 65 year life for uncracked, unsealed deck with 3-inch overlay and epoxy-coated rebar

Comments. Crack sealing is a topic of extensive study for Mn/DOT. Cracks can cut decades of life from decks, and typically require deck replacement; in such cases, sealing is unlikely to be cost-effective. Because of this, Mn/DOT focuses more research energy on crack sealing than on deck sealing.

Respondent. James Lilly, 651.747.2127, Jim.Lilly@dot.state.mn.us.

Missouri

Missouri has studied sealant performance, and will soon release a new study of sealant performance and comparison to its current specification of linseed oil and mineral spirits. MoDOT, as Mn/DOT, has consulted WHRP Study 0092-03-09, Evaluation of Concrete Deck and Crack Sealers.

Do you use protective surface treatments on new bridge decks?
- Linseed oil as scaling treatment, chloride intrusion protection, expected to last several years after construction
- Require 50% linseed oil, 50% mineral spirits
- Apply at 0.05 gallon per square yard (0.25L/m^2)
- On low slump overlays, or diamond-ground deck with build-up of linseed oil, may reduce rate to 0.025 gal./sq. yd.
- After one year, apply second coating
- Compared to tested penetrating sealers, this process has been most effective at preventing scaling and repelling chlorides

Do you reseal bridge decks with protective surface treatments? If yes, how often?
- No
- If decks crack, cracks sealed with asphalt emulsion product Pavon Indeck, viable for three years
- Recent research approved acrylic water-based sealant Star Macro Deck

Which products do you allow?
- Only linseed oil, per above
- Change order for new decks with excessive cracking, or special provision, may approve reactive silicate sealers
- Illinois DOT is observing reactive silicate sealer on a Missouri-Illinois bridge over the Mississippi River
- MoDOT laboratory test results of reactive silicate sealer have not been promising

- Crack sealers include Pavon Indeck, Star Macro Deck

How do you approve protective surface treatment products for use in your state?
- AASHTO, ASTM specifications have certified linseed oil
- Linseed oil on MoDOT Pre Acceptance List

Cost-benefit information for resealing bridge decks?
- Linseed oil 50/50 with mineral spirits, 3-year life, $0.017/sq. ft.
- Silane 55, 5-year life, $0.18/sq. ft.
- Star Macro Deck 50/50 with water, 3-year life, $0.08/sq. ft.
- Reactive silicate 1, 2-year life, $0.15/sq. ft.
- Reactive silicate 2, 10-15-year life, $0.70/sq. ft.
- A construction project let November 18, 2005, bid with reactive silicate sealer including surface preparation, labor, materials at $0.53/sq. ft.

Comments. Recent research confirmed past research, showing linseed oil outperforms penetrating sealers and crack sealers in 90-day ponding tests, salt scale tests, though on certain additional tests the penetrating sealers and crack sealers performed well. Results of study seem to match WHRP Study 0092-03-09, Evaluation of Concrete Deck and Crack Sealers. Alternatives to linseed oil may be approved by special provision, change order, or for maintenance. The MoDOT study will be available soon.

Respondent. John Wenzlick, Organizational Performance Engineer, Missouri Department of Transportation, 573.751.1039, John.Wenzlick@modot.mo.gov.

Ohio

Ohio DOT current specifications and practice, like those of Mn/DOT, focuses more on crack sealing methods and products than on deck sealing. Preventive maintenance initiatives in ODOT, however, do recommend sealing decks every five years.

Do you use protective surface treatments on new bridge decks?
- Bride design manual specifies sealing parapets, deck edges, substructure concrete with epoxy urethane sealers, per C&MS 512.03(1)

Do you reseal bridge decks with protective surface treatments? If yes, how often?
- Internal policy in place – see **Ohio.Policy.pdf**, attached
- No state process established
- Preventive maintenance Web site – http://www.dot.state.oh.us/preventivemaintenance/decks/deck3.htm – recommends sealing every five years

Which products do you allow?
- For crack sealants, see Bridge deck repair Web site – http://www.dot.state.oh.us/preventivemaintenance//repairs/deckrepairs.htm – and approved materials list at http://www.dot.state.oh.us/preventivemaintenance//Specifications/PM_references.htm
- Required as remedial work for cracking and spalling

How do you approve protective surface treatment products for use in your state?
- Based on departmental specifications and placed on a Qualified Products List

Cost-benefit information for resealing bridge decks?
- NA

Respondent. John Randall, Bridge Operations and Maintenance Section, Ohio Department of Transportation. 614.387.6210, john.randall@dot.state.oh.us.